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ORIGINAL PAPER PRACA ORYGINALNA

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The effectiveness of prevention of occlusal disorders in dental caries

Skuteczność zapobiegania zaburzeniom okluzji w próchnicy

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Keywords

occlusal disorders, analysis of occlusion, tooth restoration, prevention of occlusal disorders

Słowa kluczowe

zaburzenia okluzji, analiza okluzji, odbudowa zęba, zapobieganie zaburzeniom okluzji

Summary

Introduction. Under the concept of occlusion, we understand the harmony between the dental arches, TMJ and neuromuscular system (masticatory muscles). Occlusal contacts play an important role in ensuring physiological occlusion.

Dental caries is one of the main reason of occlusal disorders. In economically developed countries, it affects 95-98% of the population. Carious process causes changes in location of occlusal contact points, which is the reason of atypical mandibular movements. As a consequence, tooth overload and occlusal trauma are observed.

Aim. The purpose of our research is a prevention of occlusal disorders by the method of composite restoration of affected occlusal surfaces considering functional anatomy with father checking of occlusal relationships with the help of computerized system T-Scan Novus.

Material and methods. For this we have chosen 90 first-/second-/third-year students of Ivano-Frankivsk National Medical University at the age of 17-20, who were the citizens of the regions with low level of fluoride. Half of them had carious lesion of first molars, another 45 students had first molars, which were restored without principle of occlusion. Treatment was carried out by methods of direct and indirect restoration of occlusal surfaces taking into account the functional anatomy.

Results. The article contains the results of redistribution of occlusal contact in first molar with carious lesion (decrease in the occlusal load on the affected tooth, occurrence of overload on the tooth with larger area of chewing (occlusal surface) and restoration of first molar without taking into account the principles of functional anatomy (occurrence of occlusal interferences directly on it). Further restorations of chewing surfaces of first molars considering the occlusal determinants led to an even distribution of the occlusal force on the molars.

Conclusions. The obtained results of our study demonstrate the effectiveness of created treatment and prevention complex.

Streszczenie

Wstęp. Okluzja jest rozumiana jako harmonia między uzębieniem, stawem skroniowo-żuchwowym i aparatem nerwowo-mięśniowym (mięśnie żucia). Kontakty okluzyjne odgrywają ważną rolę w zapewnieniu fizjologicznej okluzji. Jednym z najczęstszych czynników występujących w okluzji jest próchnica. W krajach rozwiniętych gospodarczo zapadalność sięga 95-98%. Proces próchnicowy powoduje zmiany w położeniu punktów w kontakcie zgryzowym, co jest przyczyną nietypowych ruchów żuchwy. W efekcie dochodzi do przeciążenia zęba i powstania urazu okluzyjnego.

Cel pracy. Celem naszych badań jest wczesne zapobieganie zaburzeniom zgryzu poprzez odbudowę dotkniętych powierzchni żucia z uwzględnieniem anatomii funkcjonalnej i późniejszą weryfikację relacji okluzyjnych za pomocą skomputeryzowanego systemu T-Scan Novus.

Materiał i metody. Do badań wybraliśmy 90 uczniów roczników I-III IFNMU w wieku 17-20 lat, mieszkających w regionach o niskim poziomie fluoru, z których połowa ma próchnicę pierwszych zębów trzonowych, a pozostałe 45 – odbudowy wykonane bez okluzji. Zabieg wykonano metodami bezpośredniej i pośredniej odbudowy powierzchni żujących z uwzględnieniem anatomii czynnościowej.

Wyniki. W artykule przedstawiono dane dotyczące zmian redystrybucji kontaktów okluzyjnych w zmianach próchnicowych pierwszego zęba trzonowego (zmniejszenie obciążenia żucia chorego zęba, przeciążenie zęba o większej powierzchni okluzyjnej) oraz odbudowy pierwszego zęba trzonowego bez uwzględnienia wymagania anatomii funkcjo-

Conflict of interest
Konflikt interesów
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nalnej (nacisk na okluzję). Dalsza odbudowa powierzchni żucia chorych zębów z uwzględnieniem uwarunkowań okluzyjnych oraz ponowna analiza okluzji wykazały równomierny rozkład nacisku żucia na zęby trzonowe.

Wnioski. Uzyskane dane świadczą o skuteczności stworzonego kompleksu leczniczo-profilaktycznego.

INTRODUCTION

Occlusion is the closure of dental arches or individual groups of teeth over longer or shorter periods of time. Its disorders lead to pathological processes in masticatory system. Occlusal contacts are the key to muscle and joint harmony and the functioning of TMJ.

Centric relation of jaws is considered to be a position of functional comfort for the components of masticatory system (1-5).

Contacts of central relationships of the jaws are the guides to achieve the closing of the jaws. Their perfect location is on distolingual cusp ridge of mandibular first molars and mesiolingual cusp ridge of maxillary first molars, which leads to the possibility of movement of the lower jaw forward and up to achieve interarch (buccolingual) relationship. Research of foreign authors have shown that in the case of buccofissure contacts of dental antagonists (opposite teeth) the largest (maximum) chewing force arises on molars: 13.3% ± 4.3 and 13.6% ± 5.4 – on first molars, 15.7% ± 7.1 and 18.7% ± 7.5 – on second one.

It was proved that starting point of contacts of central relationships in oral cavity could appear on different teeth. Such location of contacts of central relationships is considered as occlusal interferences (1, 6-8).

Occlusal interferences form a variety of displacement of the mandible during closure under the influence of guide occlusal surfaces. As a result, there is a pathological process in the masticatory system (1, 7, 9).

Dental caries is one of the main factors of occlusal problems that results in changing location of occlusal contact points and is the cause of atypical mandibular movements. As a result, occlusal overloading and trauma are observed (1, 2, 5, 9-11).

Numerous studies have shown that occlusal surfaces of the first molars are the most vulnerable for caries process. The permanent bite begins to form with the eruption of the first molars. Their position determines the ratio of dentition and the height of central occlusion. Early carious lesion leads to the emergence of occlusal interference on intact groups of teeth, to disorders of statistic and dynamic occlusion, which are causal or concomitant factors in the occurrence of TMJ changes (1, 9).

The methods of direct or indirect restorations without considering the determinants of occlusion are often used to treat carious lesions of tooth surface. The design of the restored tooth surface has an important influence on the number and location of occlusal contacts, and should take into account static and dynamic occlusal relationships. The shape of the tooth, contacts with adjacent teeth and antagonists are the main occlusal determinants, that provide chewing, aesthetics, pronunciation and protection. The ignorance of these requirements of functional anatomy leads to occlusal trauma (6, 8).

AIM

The purpose of our study was early prevention of occlusal disorders in carious lesion first molars with the help of modern methods of restoration.

MATERIAL AND METHODS

To study the correlation of the occurrence of occlusal interferences in carious lesion teeth, we used results of our preliminary study on early prevention of occlusal disorders (12) in which:

1. We examined 90 first-/second-/third-year students of the Ivano-Frankivsk National Medical University (45 of them with occlusal decay of first molars, another 45 – with first molars, which were restored without principle of occlusion) with the help of computerized occlusion analysis system T-Scan Novus. It allowed us to visualize on the screen in 2D and 3D images of all the contacts that occur between the teeth of the upper and lower jaws, time and sequence of occurrence of contact, the location and the trajectory of the center of force (balance between right and left side).
2. Restoration of uniform distribution of chewing load was carried out using methods direct and indirect restoration with taking into account occlusal determinants and the following computer analysis of occlusion before, immediately after and 6 months after treatment.

To confirm the effectiveness of the therapeutic and preventive complex developed by us, we conducted re-analysis of the occlusal load distribution by the T-Scan Novus system 12 month after treatment.

The statistical analysis of the data distribution by Shapiro-Wilk W-test showed that the absolute majority of the received measurements were not correspond to the normal Gauss theorem ($p < 0.05$). Therefore, to describe the typical values (measure of central tendency) the median (Me) and interquartile range (lower quartile – LQ, upper quartile – UQ) are selected. Accordingly, statistical significance of the difference in data in the comparison groups was also estimated non-parametric methods: inside the group for comparison with the data before treatment – criterion of signs; between separate groups – Mann-Whitney U test.

RESULTS

The data obtained with use of the T-Scan Novus system showed that due to caries of first molar (fig. 1)

the highest accent of chewing load is observed on the neighboring second molar 17.2 (15.1-22.9)% and the first molar antagonist 16.1 (12.8-17.5)%. On the opposite side in the area of posterior teeth clearly expressed occlusal interferences not observed, fluctuation ranging from 11.2 (6.7-14.8)% to 13.6 (11.2-16.1)% on first molars and from 13.2 (11.4-15.2)% to 14.1 (12.1-18.2)% – on second ones.

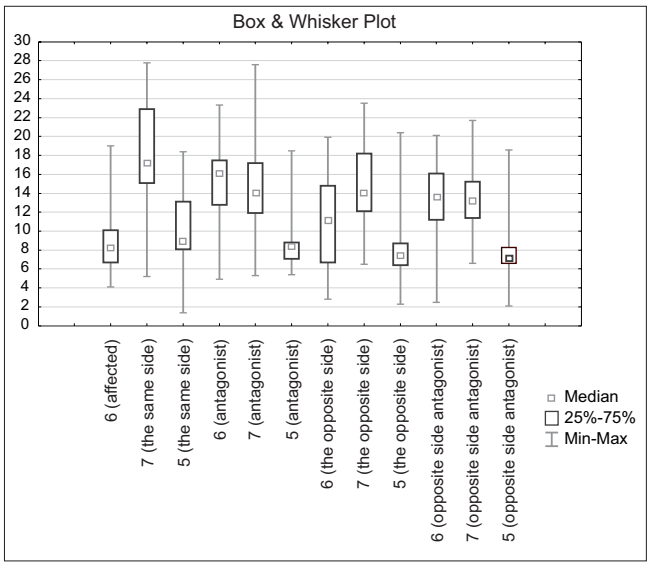

Fig. 1. Median rates of tooth chewing load emphasis in 45 students with caries of first molar

In the case of restoration of first molar without counting principles of functional anatomy (fig. 2) occlusal overload occurs directly on this tooth 18.7 (17.7-21.4)% and on the opposite one 17.1 (15.4-17.9)%. Chewing load is evenly distributed on the next adjacent posterior tooth 13.4 (12.1-14.5)% and antagonist 14.2 (13.9-14.8)%, also on molars on opposite side of jaw 12.5 (12.3-12.9)% - 12.7 (12.4-12.9)% – the first ones, 14.0 (13.6-14.2)% - 14.1 (13.8-14.3)% – the second ones.

After the restoration of the caries-affected first molars, the results of occlusion analysis immediately, 6 and 12 month after, showed and even distribution of the occlusal load on molars, namely the increase of chewing load is directly proportional to the increase of occlusal surface area. Chewing load on the restored molar increased to 12.6 (12.2-12.9)% ($p < 0.001$) (fig. 3) and decreased to 14.0 (13.1-14.2)% ($p < 0.001$) (fig. 4) on the nearby second molar in 12 months. On teeth antagonists occlusal load is 13.5 (12.3-14.8)% ($p < 0.05$) (fig. 5) and 14.1 (13.3-15.1)% ($p < 0.01$) (fig. 6) respectively. On the opposite side of the jaw no significant changes are observed (fig. 7).

The results of occlusal analysis with T-Scan Novus system 12 month after re-treatment of the first molar with the principles of functional anatomy have demonstrated even distribution of occlusal load on the teeth (fig. 8), redaction of chewing load to 12.4 (12.3-12.5)% ($p < 0.001$) directly on first molar (fig. 9) and to 12.6 (12.4-12.7)% ($p < 0.001$) on antagonist (fig. 10).

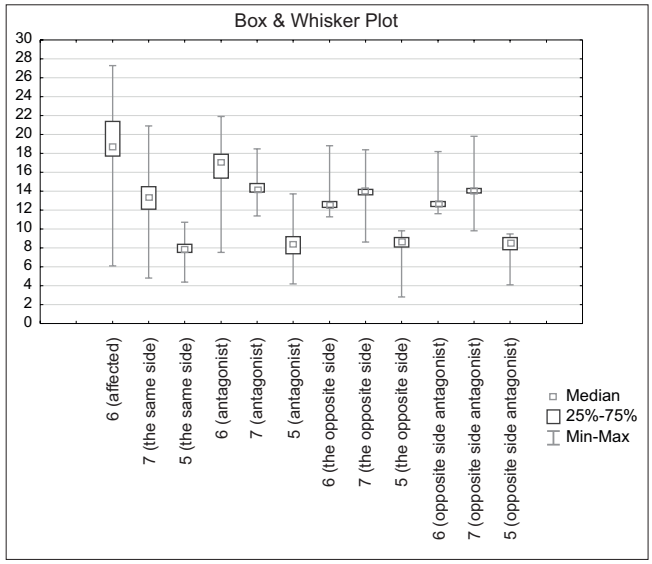

Fig. 2. Median rates of tooth chewing load emphasis in 45 students with first molars restorations without principle of occlusion

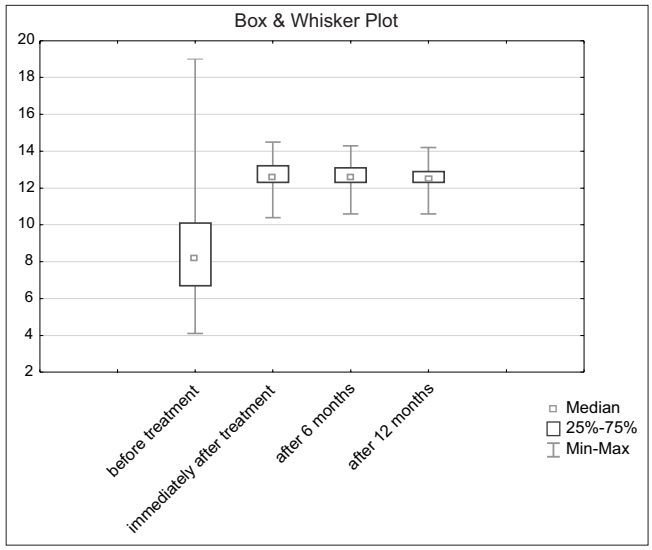

Fig. 3. Median rates of tooth chewing load on first molar 12 after treatment

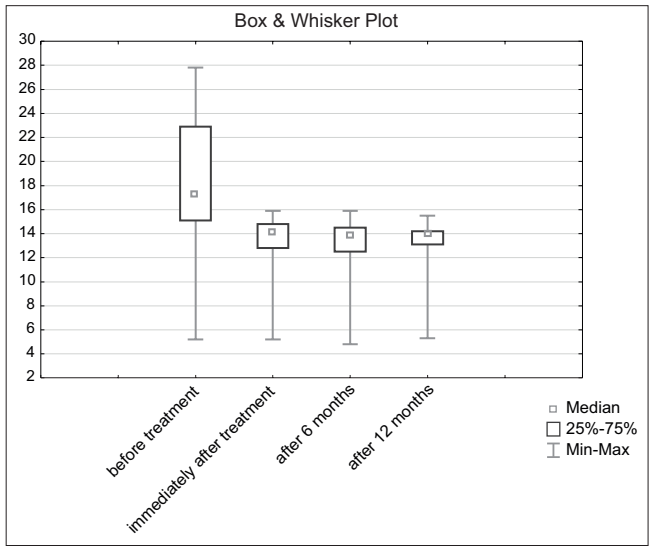

Fig. 4. Median rates of tooth chewing load on second molar 12 after treatment

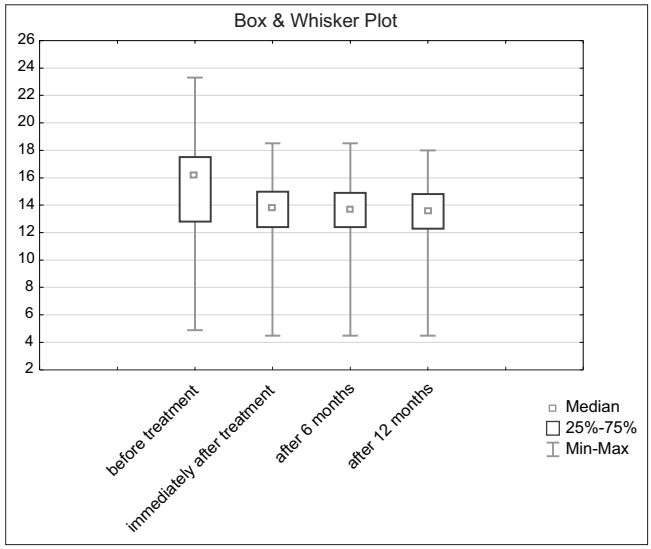

Fig. 5. Median rates of tooth chewing load on first molar-antagonist 12 after treatment

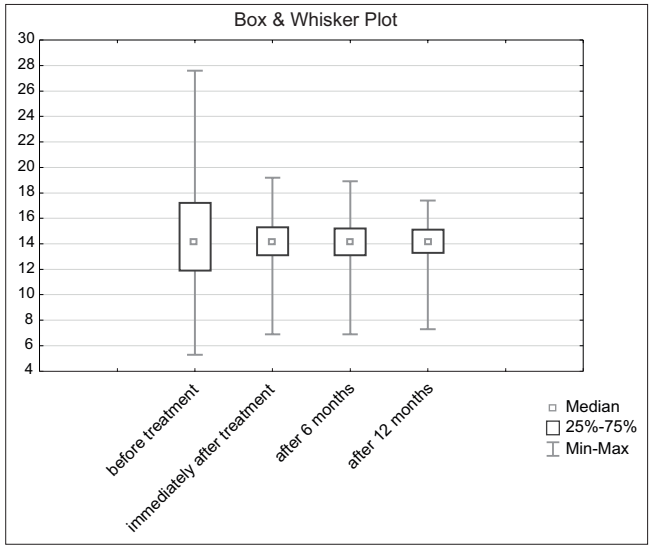

Fig. 6. Median rates of tooth chewing load on second molar-antagonist 12 after treatment

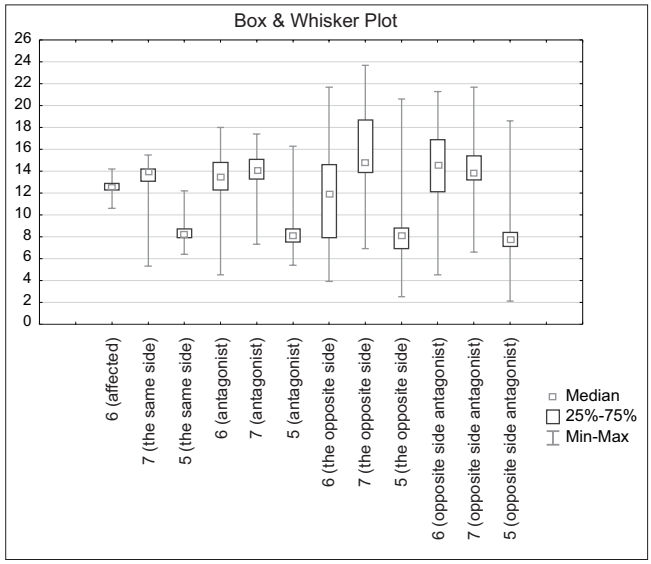

Fig. 7. Median rates of occlusal load on the teeth 12 months after treatment

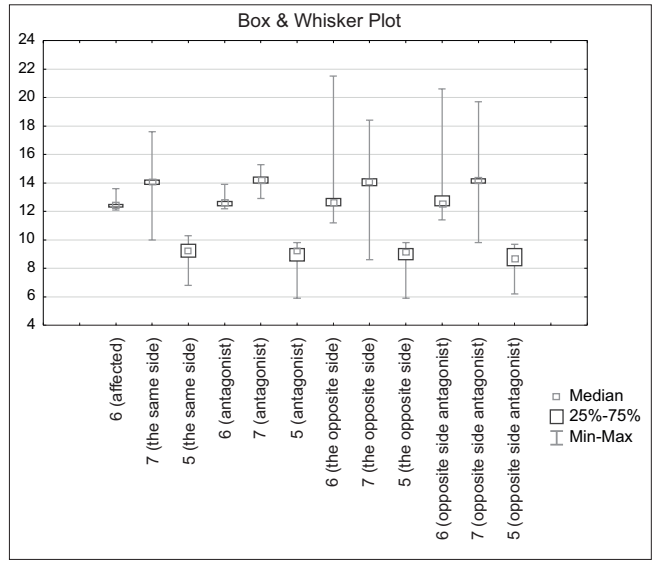

Fig. 8. Median rates of occlusal load on the teeth 12 months after re-treatment

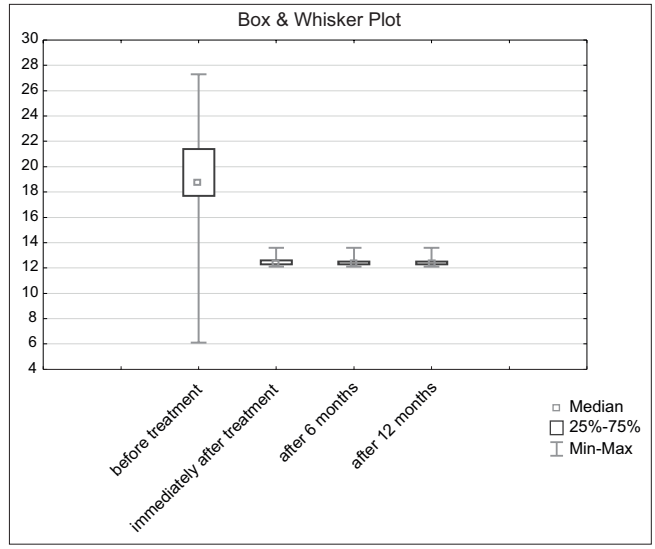

Fig. 9. Median rates of tooth chewing load on first molar (re-treatment)

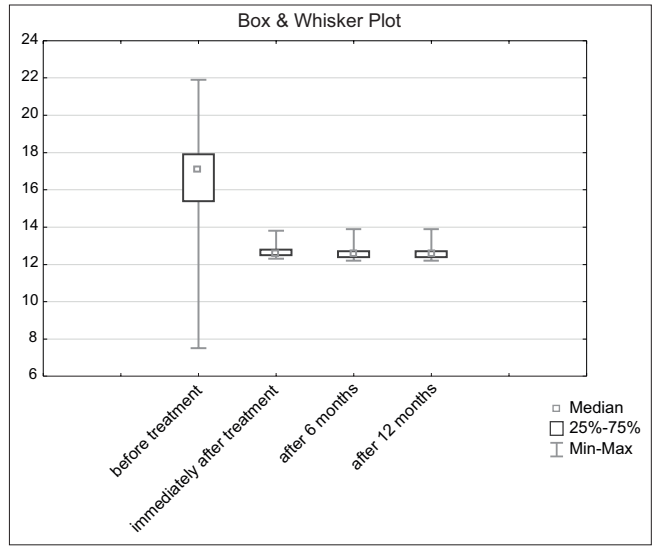

Fig. 10. Median rates of tooth chewing load on first molar-antagonist (re-treatment)

DISCUSSION

Having analized the data obtained and studies of foreign authors (8) about the occlusal load on intact first molars (13.3% ± 4.3 and 13.6% ± 5.4) we can a assume the following: carious lesion of the first molar leads to redistribution of occlusal contacts (a decrease in the chewing load on the affected tooth to 8.2 [6.7-10.1]%), accent of occlusal load is transferred to the tooth with a larger area of chewing (occlusal) surface, namely the second molar (increased to 17.2 [15.1-22.9]%).

The restorations of first molar without considering the principles of functional anatomy caused the occurrence of occlusal interferences on it (18.7 [17.7-21.4]%), the similar situation was observed on the antagonist tooth (17.1[15.4-17.9]%). Computer analysis of occlusion using the system T-Scan Novus showed that restorations of chewing surfaces of first molars with taking into account the occlusal determinants lead to a uniform distribution of the masticatiry load on the molars (on the restored tooth the occlusal load increased to 12.6 [12.3-13.1]%, on neighboring molars – decreased to 13.9 [12.5-14.5]%; accent of chewing load decreased to 12.4 [12.3-12.5]% on the re-treated first molars and increased to 14.1 [13.9-14.2]% on the next molars).

The obtained results supplemented by the authors' publications about the problem of the mechanism of origin and correlation relationships of occlusal disorders and carious disease, which indicate that teeth with carious lesions have formed signs and symptoms of occlusal overload.

CONCLUSIONS

The data obtained using the T-Scan Novus system showed a presence of correlation between occlusal overload in carious lesion teeth and restored teeth without considering the principles of functional anatomy. We have been restored the occlusal surfaces of first molars with taking into account all occlusal determinats and futher prevention of occlusal disorders. Computerized re-analysis showed uniform distribution of chewing load and absence of occlusal interferences on the molars. The results of our research indicate the effectiveness of treatment and preventive complex.

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